OPERATION MANUAL

VCM-64
Voice Command Module

HIGH TEC
CARTON

CHIRPEE
SALE CARTON

for

Commodore-64
with Disc Drive

Operation Manual Corrections
for
VCM–64 Voice Command Module

Please make the following corrections to your new VCM–64 operation manual.

Page No.	Manual Reads	Change To Read	No. of Places
5	Chirpee	VCM	1
8	Chirpee	VCM	3
8	Under Note: change the following file names that should not be used for lexicons or programs added to the master VCM-64 lists:		
	Was	Change To	
	SGMC	Plot	
	AMC	Balloon	
	Chirpee	VCM	
	CFMC	Text	
	Aerodemorex	Aerolex	
14	Chirpee	VCM	1
16	Chirpee	VCM	4
17	Chirpee	VCM	3
18	Chirpee	VCM	1
19	Chirpee	VCM	3
17	Word Label LB$ = —	Word Label LB$ = ((	1
17	Manual Reads For M=0 To 14 :LB$=LB$+CHR$(PEEK(53002 + M) :NEXT M Change To For M=0 To 14 :LB$=LB$+CHR$(PEEK(53002 + M)) :NEXT M		1
17	Add line to sample program 65 CN=PEEK (53001)		1

Manual For DISC Dated
After August 19, 1985

OPERATION MANUAL

INTRODUCTION

The VCM-64 Voice Command Module is a speech recognition device that lets you give commands to your Commodore-64 with your voice instead of a keyboard. VCM-64 converts the sound waves generated when you talk into digital data that is stored in the computer memory. When you speak to your computer, the words you speak are matched against the data stored in memory and the result is converted to an instruction for the computer to perform.

EQUIPMENT

You will need a Commodore-64 computer, a Commodore 1541 disk drive, a monitor (or TV) to use the VCM-64 system. The system has three components:

1) Speech Module	The speech module is the actual hardware box that you plug into the USER PORT on the computer.
2) Floppy Disk	The disk contains software to operate the VCM-64 system as well as instruction and demonstration programs that teach you how to use the system.
3) Lapel Microphone	The lapel microphone picks up your voice. It plugs into the rear of the VCM-64 module.

SETUP

Connecting the VCM-64 to the Commodore-64

Check to see that the Commodore-64 keyboard power is turned OFF. Now insert the VCM-64 cable plug into the USER PORT at the rear left corner of the keyboard, as shown in Figure 1. Make certain that the word "TOP" on the cable plug is facing upward, and that the plug is seated securely into the USER PORT. If the cable plug is not inserted correctly, the system will not operate properly, or the VCM-64 module may be DAMAGED when the power is turned on.

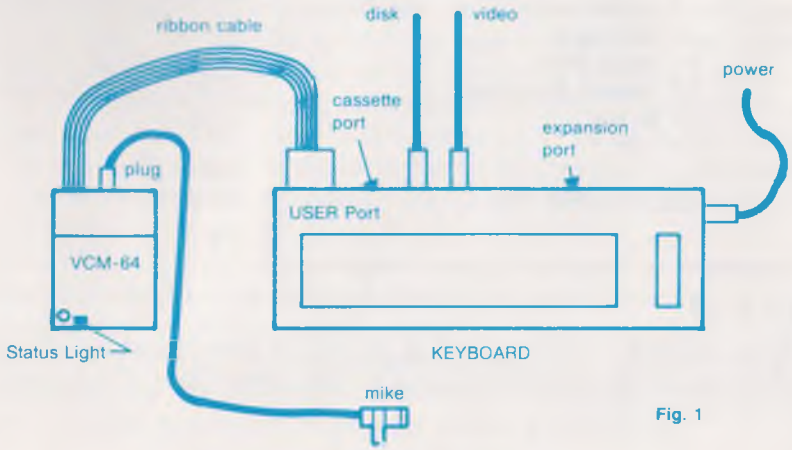

Fig. 1

Connecting the Microphone

The lapel microphone is plugged into the small hole at the back of the VCM-64 module as shown in Figure 1. Make certain that the plug is firmly inserted. Attach the microphone to your clothing as shown in Figure 2. Lay any extra microphone cable in a convenient location, but avoid wrapping it with other computer cables or power cords.

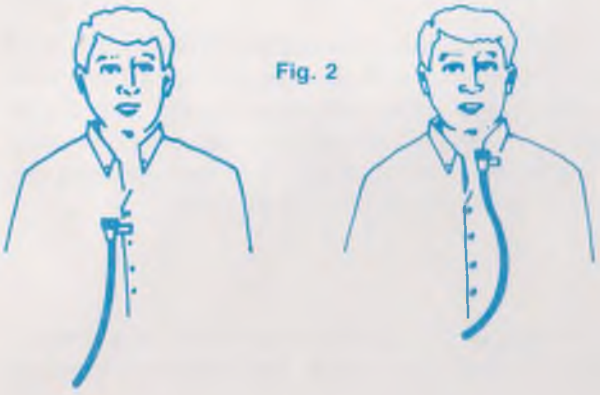

Fig. 2

Turning the Power ON

Once the VCM-64 is properly connected, the power can be turned on. Turn on the monitor and disk drive first, then the keyboard. If everything is in place, the "STATUS" light on the VCM-64 module will blink slowly three times and then stay OFF. The VCM-64 is now ready for operation.

Loading the Program

Check the monitor. When the word READY appears, insert the master floppy disk into the disk drive and type:

LOAD"*",8

and press the RETURN key and wait. When the word READY reappears, type:

RUN

and press the RETURN key again. The initial LOADER MENU will appear on the screen as shown in Figure 3. This menu lists all of the demonstration and training programs on the master disk. Descriptions of each program are discussed in the DEMONSTRATION PROGRAMS section.

LOADER MENU

Fig. 3

POWER OFF

NEVER remove the VCM-64 cable plug from the Commodore-64 USER PORT while the keyboard power is ON. Turn OFF the power BEFORE disconnecting the VCM-64 cable plug.

VCM-64 COMMAND TIPS

The VCM-64 system uses a special word matching technique. When you first begin to use the VCM-64, you have to speak a set of words to the system. This is called "building a lexicon." The data for the sound waves for each word is stored in the computer memory. From then on, when you give the system a command, it will try to match the sound waves of the command with the sound waves it has in its memory. If the sound waves match, it will relay to the computer which command it heard. It is very important, therefore, that you give each command in the same tone and with the same stress and pitch that you used when you built the lexicon.

GIVING COMMANDS

Here are some tips to remember when giving commands:

1) **Remember how you gave the command.** When you build your lexicon, speak clearly and distinctly into the microphone and remember the pronunciation and pitch you use. It helps to write down the words with accent notations. When giving the command, you must speak clearly and use the same pronunciation. Remember that what you say is not as important as how you say it.
2) **Choose commands that are familiar.** Try to pick command words that you normally use. These words are more easily repeated.
3) **Choose commands that are not similar.** Vary the number of syllables in your commands as well as the sound of the word. If two words sound similar, they will have similar sound waves. The VCM-64. could have trouble distinquishing the difference between the two commands and it may send the wrong instruction to the computer.
4) **Watch the length of your commands.** Commands should be longer than 0.2 second, but no longer than 1.2 seconds. If the command is too short or too long, the system will not be able to correctly respond.
5) **Place the lapel microphone in the same location each time you use it.** Make sure there is nothing in the way to block or cover the microphone. It should be attached to your clothing as shown in Figure 2.
6) **Keep the room noise as consistent as possible.** If you build a lexicon in one room, continue to use it in that same room. Different noise levels and acoustics can make it difficult for the VCM-64 to correctly distinquish between commands. If background noises or other voices in the room are too loud, the STATUS light on the VCM-64 will continue to blink rapidly. The VCM-64 cannot accept information while the STATUS light is blinking rapidly. Reduce the interference by moving to a quieter place.

The VCM-64 master disk has a program that shows you how important it is to match the way you give a command to the way you used when you built the lexicon. This program is call "Speech Graphics," and is explained under DEMONSTRATION PROGRAMS. It is recommended that you start with this program before trying to use the other demonstration programs or building a lexicon, because it will help you learn the correct speaking technique.

CHECKLIST FOR CORRECTING PROBLEMS

Problem	Reason	Solution
STATUS light continues to blink after power is turned ON.	Cable plug was not inserted in the USER PORT correctly.	Turn keyboard OFF and re-insert plug, making sure the word "TOP" is facing upward. Turn power ON again.
	Power supply voltage to USER PORT too low.	Have dealer check power supply voltage at USER PORT to be at least 4.75 volts.
STATUS light will not go on or blinks only once.	Cable plug was not inserted into the USER PORT correctly.	Turn keyboard OFF and re-insert plug, making sure the word "TOP" is facing upward. Turn power ON again.
STATUS light will not stop blinking.	Background noise or nearby conversations are too loud.	Reduce interferring noise or move to a quieter place.
	Electrical interference is reaching microphone cable.	Move microphone cable away from other computer or power cables. Turn off any source of transmission nearby, such as a CB radio.
Computer will not respond.	You gave it the wrong word.	Check the wording you used in building the lexicon. Retrain that word if necessary.
	You spoke the word with the wrong pronunciation.	Check the pronunciation notes you made when building the lexicon. Retrain if necessary.
	STATUS light was blinking when you gave the command.	Wait for the STATUS light to glow steadily. Reduce noises around you (see above).
	The module cannot recognize your voice.	Speak clearly, be sure nothing is blocking the microphone.
	You spoke the command too softly.	Use "Speech Graphics" to learn the proper sound level.
Computer responds incorrectly.	Two of your commands are too similar for the computer to distinquish the difference.	Change one of the commands. Watch your pronunciation.
	You spoke too softly when you built your lexicon.	Use "Speech Graphics" to learn the proper sound level. Then rebuild your lexicon.

DEMONSTRATION PROGRAMS

There are six programs on the VCM-64 master disk. They may be loaded individually or run by using the automatic loader. To use the automatic loader, type:

LOAD"*",8

and press the RETURN key. Wait for the word READY to reappear, and then type:

RUN

and press the RETURN key again. The initial LOADER MENU will appear as shown in Figure 3. Any of the programs may be loaded and run automatically by simply pressing the number of the desired program. Pressing a (7) for Exit will cause the computer to reset itself to the normal conditions found when you first turn on the power.

Fig. 3

Each of the demonstration and training programs will be described in the following sections. These are given in the order that they appear on the LOADER MENU, but it is strongly recommended that you begin with "Speech Graphics" first, in order to learn how the VCM-64 works. Then proceed to "SOS" to build a lexicon for one of the other programs.

SOS (Speech Operating System)

The Speech Operating System (SOS) is the general utility program which helps you to build a speech file made up of a set or words. This is commonly referred to as "training" a "lexicon" of words.

This program may be run by pressing "1" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"SO",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. The SOS MENU will appear on the screen as shown in Figure 4. This menu provides seven functions for viewing, building, modifying and copying files and lexicons. Once a selection is made, the status bar will change color to the selected function and one or more questions may appear in the information space below the status bar. When you are finished with SOS, press the F1 key to get the automatic loader and the LOADER MENU will reappear.

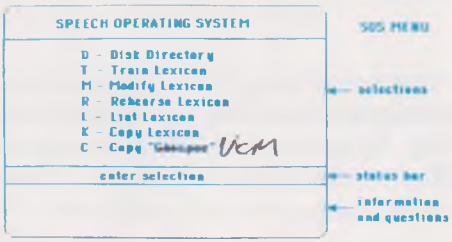

Fig. 4

Viewing the Disk Directory
Any disk can have its contents examined by pressing the "D" key while viewing the SOS MENU. Insert the desired disk to be read into the disk drive and hit any key to read the disk and display its contents in sets of ten files or printout the directory on a printer. If the directory is displayed, the F7 key may be pressed to view the next set of ten files, if any; and the F1 key may be pressed to quit viewing disk files and return to the SOS MENU. If the directory is printed, the SOS MENU will reappear after the printout is completed.

Building a Lexicon
A lexicon of command words can be built by pressing the "T" key while viewing the SOS MENU. You will be asked for the name you wish to call the lexicon. Enter any name of less than 16 characters that has not already been used. The SOS MENU will disappear and you will be asked how many commands you wish the lexicon to have. Enter the number (must be less than 64). The SOS program will then determine how many samples of each command will fit into its lexicon memory, and ask you to enter the word label for each command. This word label is a reminder to you of what word to say during training, but it is also used by some demonstration programs to show what the command does. The word label DOES NOT have to be the word you say.

Type in the word labels for each command as the computer asks for them. If you make a mistake, use the DEL key to back up your typing. When finished with each command, press the RETURN key. When you have finished typing in all the word labels, be ready to say the command words you have selected. The computer will now ask you to say each command word. WAIT for the STATUS light on the VCM-64 to glow steadily, and say the requested word clearly and distinctly into the microphone. The computer may ask for more than one set of samples of each command word. The number of sets left to be done is given on the screen. After each set is completed, the computer will pause until you press the F7 key to continue.

After you have entered all the commands, the SOS MENU will reappear and the lexicon file will be stored onto the disk in the disk drive. If the name of the lexicon file already exists on that disk, you will be asked if you wish to replace it. If not, you will be asked for another name to use, or you may change disks. After the lexicon is stored to disk, make sure that all your command words were entered correctly by rehearsing the lexicon.

Modifying a Lexicon
A previously built lexicon can be modified by pressing the "M" key while viewing the SOS MENU. If a lexicon currently exists in memory, you will be asked if it is the one to be modified. If not, place the correct disk in the disk drive and enter the name of the lexicon file to be modified. Once a lexicon has been selected, a modify menu will appear with the type of changes that are available.

Press the F7 key if you want to change the sound wave data (utterance) saved for a command. This will leave the word labels untouched. The computer will request the number of the command to be changed. BE SURE to enter a number, not the word label. The computer will then display the word label for the command and ask you to say the command several times. When finished, you may press the F7 key to change another utterance. Otherwise, press the F1 key to return to the modify menu.

Press the F5 key if you just want to change the word label for a command, without having to retrain the word. You will then be asked for the number of the command to be changed. BE SURE to enter a number, not the word label. The computer will then display the command number and the old word label. Type in the new word label and press the RETURN key. You may change another word label by pressing the F7 function key, or you may return to the modify menu by pressing the F1 key.

Press the F3 key if you just want to change the lexicon file name, without having to retrain the lexicon. This will cause the SOS MENU to reappear and ask you for the new file name you wish to use. Type in the new file name and press the RETURN key. The lexicon will be stored to disk under that name. The old lexicon file WILL NOT be erased from the disk.

Press the F1 key when you are finished with modifications. The SOS MENU will reappear and the computer will replace the old lexicon file on the disk with the new, changed version.

Rehearsing a Lexicon

A previously built lexicon can be rehearsed by pressing the "R" key while viewing the SOS MENU. If a lexicon currently exists in memory, you will be asked if it is the one to be rehearsed. If not, place the correct disk in the disk drive and enter the name of the lexicon file to be rehearsed. Once a lexicon has been selected, the screen will change to show the name of the lexicon being rehearsed and two boxes for the number and word label of the recognized command. Pressing the F7 key will allow the VCM-64 module to "listen" for a command. Wait for the STATUS light to glow steadily, and say the command clearly and distinctly into the microphone. The recognized results will then be displayed. Press the F7 key again to try another command.

If the wrong command is recognized, two commands are probably too similar or you used a slightly different pronunciation. If a particular command or pair of commands consistently give poor results, one or both should be retrained using the modify method described above. Press the F1 key to quit rehearsal and return to the SOS MENU.

Listing a Lexicon

A previously built lexicon can be listed by pressing the "L" key while viewing the SOS MENU. If a lexicon currently exists in memory, you will be asked if it is the one to be listed. If not, place the correct disk in the disk drive and enter the name of the lexicon file to be listed. Once the lexicon has been read, the number and word label for each command can be displayed in sets of ten or printed on a printer. If the list is displayed, press the F7 key to show the next set of ten, if any; and press the F1 key to return to the SOS MENU. If the list is printed, the SOS MENU will reappear when the listing is done.

Copying a Lexicon

A previously built lexicon can be copied to another disk by pressing the "K" key while viewing the SOS MENU. If a lexicon currently exists in memory, you will be asked if it is the one to be copied. If not, place the correct disk in the disk drive and enter the name of the lexicon file to be copied. Once a lexicon has been selected, you will be asked to insert the destination disk to which you want the lexicon file copied. When ready, press any key to complete the copy process.

Copying the "~~Chirpee~~ VCM" File

The "Chirpee" program is a special machine code program that is loaded into the computer to do the actual gathering of speech data from the VCM-64 module and comparing this data to the stored lexicon of words. Since this is a machine code program, it is normally difficult to copy from one disk to another. Pressing the "C" key while viewing the SOS MENU will allow you to copy this program. When asked, insert the destination disk to which you want "Chirpee" to be copied and press any key to complete the process.

NOTE:

The following file names should not be used for lexicons or programs added to the master VCM-64 disk:

SO	SP	CA	WM
AE	AD	~~AMC~~Balloon	~~CFMC~~ Text
~~SGMC~~ Plot	LOADER	~~CHIRPEE~~ VCM	~~AERODEMOLEX~~ Aerolex

Use of any of these names may cause these files to be replaced and some of the demonstration programs will not work.

Card File Program

The Card File Program is much like an index card file which you can control with your voice. You can store recipes, addresses, phone numbers, or any kind of information you need to have filed. Up to 100 files may be kept on a single disk.

This program may be run by pressing "2" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"CA",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. After the program is loaded, you will be asked if you have prepared a lexicon of commands for this program. If you have, press F7 and then enter the name of the lexicon file to use. If not, press F5 and the automatic loader will load SOS and you can train your lexicon as described below. When you are finished with SOS, the automatic loader will remember where you were and reload Card File for you automatically.

Card File requires 11 commands to operate it. Build a lexicon using SOS. When asked for the number of commands, enter 11. Then enter your desired command for each of the command numbers. Keep your commands simple and easy to remember. Be careful when building your lexicon to enter your desired command for each function. *The computer will respond to the command number, not the word label.* The following list is the function of each command number. A suggested command word is given.

COMMAND	RESULTING ACTION	SUGGESTED WORD LABEL
1	Displays first 10 files on disk.	GET
2	Displays next 10 files on disk.	NEXT
3	Moves file pointer upward.	UP
4	Moves file pointer downward.	LOWER
5	Loads file next to pointer.	LOCATE
6	Allows editing of file displayed on screen.	EDIT
7	Clears screen and enters "TEXT" mode.	NEW
8	Saves current screen text as a file.	FILE
9	Prints the screen text on printer.	PRINTER
10	Executes the action currently highlighted on the screen from last command spoken.	....OK....
11	Erases currently displayed screen text and the file it came from on the disk.	ERASE

Once you have built the lexicon, you may run the Card File program. All eleven commands must be present for the lexicon to be accepted. Also, the word labels used in the lexicon will be displayed at the top of the screen when running the program.

Once Card File is running, speak any of the commands shown at the top of the screen. These are the only active commands at that time. When a command has been recognized, it will be highlighted. Once the command is highlighted, it will not be executed unless the execution command (command #10) is recognized next. If any other word is recognized, the highlighted command will be returned to normal and the action not performed. In this way, any unwanted command can be ignored by saying something like "NO, NO, NO" or other word unlike the execution command. *Be sure to watch the STATUS light on the VCM-64, so that you speak only when the light glows steadily.*

There are two exceptions to the execution command rule. The commands for moving the file pointer up and down (commands #3 or #4) DO NOT require the execute command for them to take action. The file list move command (command #2) requires either of the file pointer commands (commands #3 or #4) after it to determine the direction.

Once the program enters the "text mode," the VCM-64 is ignored and the data is typed to the screen by the keyboard. All the keys function as normal, including the INSERT, DELETE, and cursor keys. When finished with the text, press the F7 key and you will be asked for the filename to give the text. Enter the filename, and press the RETURN key. The computer will then return to listening and activate the VCM-64. The text shown on the screen WILL NOT be saved to disk automatically. Use the save command (command #8) to save the text to disk.

When finished with Card File, hold the F1 key and say "Goodbye" if you are in the voice mode. If you are in the text mode, just press the F1 key. The automatic loader will then be loaded, and the LOADER MENU will reappear.

Aeronaut Game

The Aeronaut program is a game using advanced graphics to show a hot-air balloon in the center of a screen which changes as the wind blows the balloon across the countryside.

This program may be run by pressing "3" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"AE",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. After the program is loaded, you will be asked if you have prepared a lexicon of commands for this program. If you have, press F7 and then enter the name of the lexicon file to use. If not, press F5 and the automatic loader will load SOS and you can train your lexicon as described below. When you are finished with SOS, the automatic loader will remember where you were and reload Aeronaut for you automatically.

Aeronaut requires 5 commands to operate it. Build a lexicon using SOS. When asked for the number of commands, enter 5. Then enter your desired command for each of the command numbers. Keep your commands simple and easy to remember. Be careful when building your lexicon to enter your desired command for each function. *The computer will respond to the command number, not the word label.* The following list is the function of each command number. A suggested command word is given.

COMMAND	RESULTING ACTION	SUGGESTED WORD LABEL
1	Add 9 units of lift to balloon	HOT
2	Add 6 units of lift to balloon	GAS
3	Add 3 units of lift to balloon	UP
4	Remove 3 units of lift to balloon	DOWN
5	Remove 9 units of lift to balloon	PANIC

The object of the game is to land on all five landing pads without crashing into anything or running out of fuel. The balloon's altitude (height) is controlled by your voice which adds or removes hot-air from the balloon. The direction of travel is dependent on the winds at different altitudes. You must keep the balloon at the altitude of the desired wind you want. The rate display in the lower left shows you the state of life: a (+) sign means up, and a (−) sign means down. The lift rate will continuously be lowered as the balloon "cools" naturally. The lift rate is limited to +9 or −9.

If you crash, say "Quit" to get your score. If you want to quit at other times, hold the F1 key and say "Quit" to get your score. When finished playing Aeronaut, press the F1 key, which will load the automatic loader and the LOADER MENU will reappear.

Word Mix Puzzle

The Word Mix program is a puzzle using words you speak.

This program may be run by pressing "4" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"WM",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. After the program is loaded, you will be asked if you have prepared a lexicon of commands for this program. If you have, press F7 and then enter the name of the lexicon file to use. If not, press F5 and the automatic loader will load SOS and you can train your lexicon as described below. When you are finished with SOS, the automatic loader will remember where you were and reload Word Mix for you automatically.

Word Mix requires 8 commands to operate it. Build a lexicon using SOS. When asked for the number of commands, enter 8. Then enter your desired command for each of the command numbers. Keep your commands simple and easy to remember. Since this is a puzzle, the order or type of command words are not important. A suggested list of words follows:

HIPPO	APE	DOG	CAT
BUFFALO	ELEPHANT	BABOON	ZEBRA

When Word Mix is loaded it will display the eight words to the left and eight blank lines to the right. First say each of the eight words, in any order. As they are recognized, they will be blacked out by a bar on the left and placed on each blank line on the right. When all have been recognized, the order of the words on the left is scrambled under the black bars with none of them matching the words on the right.

You will then be asked: "EXCHANGE?" Say any of the eight words on the right, and the recognized word will have an arrow behind it. You will then be asked: "WITH?" Say another of the eight words on the right, and the recognized word will also have an arrow behind it. The two words will then exchange places. If this causes one of the moved words on the right to match up with a hidden word on the left, the hidden word will be displayed. You will be asked for another exchange. The task is to exchange words until all the hidden words have been matched. The best score will be four exchanges. If you say any word by mistake, say the same word again; and the exchange will not be counted.

You may quit at any time by holding the F1 key and saying "Goodbye." This will let you load another lexicon if you wish. Otherwise, press the F1 key again to load the automatic loader and the LOADER MENU will reappear.

Speech Graphics

This program may be run by pressing "5" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"SP",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. After the program is loaded, a menu will appear describing the action of each function key.

Speech Graphics will help you understand how the VCM-64 works. It will also show you, through the use of graphics, how important pronunciation is to good recognition. First, press the F3 key to show the X-Y Monitor. The screen will display a grid with a white ball in the upper left corner. As you speak into the microphone, the ball will move quickly around the graph. If the ball tends to stay near the upper left corner, you need to speak more loudly or position the microphone closer to your mouth. You should be able to say various sounds or vowels and get the ball to "hold" at various spots near the center and lower left of the graph. Practice these sounds, trying to hold the ball at various points. When finished, press F1 to return to the main Speech Graphics menu.

Now press F5 and the screen will change to two graphs for the X and Y data as they vary with time. The VCM-64 module will be activated. Wait for the STATUS light to glow steadily, and say a command. The sound wave data will be plotted on the two graphs similar to that shown in Figure 5 (your command may produce different lines). Now press the F7 key, wait for the STATUS light to glow steadily, and say the same command again. A new set of sound wave data will be plotted with the old data. Are they similar? If not, did you pronounce the command the same? Did you speak loudly enough?

Fig. 5

Using the F5 key to clear the screen and start new graphs, or the F7 key to add new plots to old plots, practice saving command words you want to use. When you have learned the correct speaking technique, the same command repeated several times will give nearly identical plots. Also, use F5 and F7 keys to compare different command words to see if they have different sound wave data. When finished with plotting, press the F1 key to return to the Speech Graphics main menu.

When finished with Speech Graphics, press the F1 key again and the automatic loader will be loaded and the LOADER MENU will reappear on the screen.

Demo Program

The Demo program is a simpler version of the Aeronaut game using advanced graphics to show a hot-air balloon in the center of a screen which changes as the wind blows the balloon across the countryside.

This program may be run by pressing "6" while viewing the LOADER MENU. To load it directly, wait for the word READY and then type:

LOAD"AD",8

and press the RETURN key. Wait for the word READY to reappear and type:

RUN

and press the RETURN key again. After the program is loaded, you will be asked if you want to use a general purpose lexicon built with several voices or add your voice to this lexicon. If you want to use the general lexicon, it will be loaded and play will begin. Otherwise, the general lexicon will be loaded and you will be asked to say each of the four command words several times. When this is done, the play will start.

The rules for the demo are the same as for Aeronaut, except the words are easier to predict and you can only add or remove 3 units of lift at a time from the balloon. Also, you have less fuel to use. When you wish to quit, use the same methods as with Aeronaut.

CUSTOM PROGRAMMING MANUAL

~~CHIRPEE~~ VCM

On the master VCM-64 disk is a machine code program called "~~Chirpee~~ VCM." This program is used to gather, process and compare a new set of sound wave data against a stored lexicon of sound wave data. This program allows anybody to use the VCM-64 for speech recognition software by using the commands given in this manual.

KEY FEATURES

The VCM-64 system is known as a speaker-dependent isolated-utterance recognition system. It uses a novel analysis of the audio waveform and two levels of data compression in order to minimize the storage memory requirements. Each speaker must first train the system with samples of each chosen command word. These sets of command words are called lexicons. Each lexicon can be stored away as a file on a floppy disk for future reference. Also, several different speakers can share the same lexicon file.

The following statistics demonstrate the capability of the VCM-64 system when operating with a Commodore-64:

Number of utterances held in Commodore-64 memory at one time	64
Lexicon storage area	Under BASIC ROM 40960-49151 $A000-$BFFF
Maximum length of utterance	1.28 seconds
Storage technique	Phonetic Feature String Data
Recognition program	6502 machine codes
Recognition program size	4K bytes
Recognition program location	49152-53247 $C000-$CFFF

Lexicons can be stored as data files on disk, using 33 blocks of disk storage per file. Different lexicon files can be loaded into the Commodore-64 during software program execution. This gives unlimited word capability.

DATA REDUCTION

The key feature leading to the cost effectiveness of the VCM-64 system is the simple analog signal processing. Many speech recognition systems use a fast sampling A/D converter to process the speech waveform. This technique then requires further high-speed analysis to extract frequency oriented and time oriented features suitable for use as a stored reference template. These systems tend to be costly, often requiring a custom speech processing integrated circuit.

The VCM-64 system, on the other hand, uses a novel analog-to-digital peak and valley location system which is analyzed in real-time into a pair of scalar coordinates. The scalar coordinates correlate roughly in the motion of the speaker's tongue and jaw position. Every 10 milliseconds these scalar coordinates are sent to the Commodore-64 for temporary storage. The two time plots of up to 128 pairs of these coordinates can be studied in the "Speech Graphics" program provided on the VCM-64 master disk.

Once the first level of data reduction is accomplished, and an entire utterance record is stored in the Commodore-64 memory, a second data extraction program further reduces the time plots permitting good memory utilization and cost effectiveness. This opens a myriad of potential man-to-machine speech applications.

USER COMMANDS

In order for users to incorporate speech recognition into their own programs, several initial steps must be taken to setup the VCM-64 system. Then the actual recognition process can be called as required. There are various resulting data that can be used when the recognition process is completed after each received utterance.

VCM-64 Setup

At the start of any program, the "Chirpee" recognition program must be "booted" into place in memory for future system calls. This should be done at the start of the program using the following BASIC statement:

```
IF SW=0 THEN SW=1 :LOAD"CHIRPEE",8,1
```

No system calls to the "Chirpee" program should be performed before this command. Next, the VCM-64 needs to be initialized by clearing the lexicon memory area, setting up the USER PORT, and initializing structure. This can be done easily after the "Chirpee" program has been installed, by the following BASIC statement:

```
SYS50000,I
```

Since this clears both the lexicon and data buffer areas, this initialization should be done only once at the beginning of the program before any lexicon can be loaded. The VCM-64 system is now ready to receive utterances, but a reference lexicon must be loaded into memory for any meaningful results to occur. A lexicon can be loaded by the following BASIC statements:

```
OPEN 8,8,8,F$
SYS50000,L :CLOSE8
```

The value of F$ is entered by the user during program execution as the filename of the desired lexicon. If the same lexicon filename is always used, then the filename can be permanently put in the program by replacing F$ with the filename enclosed in quotation marks. Of course, these same command lines for loading a lexicon can appear later again in the program if different lexicons are required for various conditions. Just be sure that at least one lexicon has been loaded before any recognition is to take place.

Recognizing Utterances

After the setup procedures, the VCM-64 is ready for utterance. The actual listening and recognition of utterances during the program is done by a system call to the listen/recognize routine in the "Chirpee" program code. This can be done only by the following BASIC statement:

```
SYS50000,F
```

This will send a request to the VCM-64 to wait for a 0.5 second long silence before synchronizing on the next word/phrase. The listening is halted when another 0.5 second silence is encountered or if the word/phrase exceeds 1.28 seconds in duration, whichever occurs first. When the utterance has terminated, the recognition routine will automatically process the data and compare the result against all the other stored words in the current lexicon. If a good match is found, the resultant lexicon word location (WL), word label (LB$), and command number (CN) are stored to specific memory locations for use by the program calling recognition routine.

Recognition Results

The results of the recognition decision can be used by the program to determine the appropriate action to take. These results can be examined as follows:

Word Location
WL=PEEK (53000)

Command Number
CN=PEEK (53001)

Word Label

```
LB$=""
FOR M=0 TO 14 :LB$=LB$+CHR$(PEEK(53002+M)):NEXT M
```

Under normal circumstances, determining the command number (CN) is the easiest approach since the ON X BASIC statement can be used to go to the appropriate program step. A sample program is as follows:

```
10  IF SW=0 THEN SW=1 :LOAD"CHIRPEE",8,1 {load Chirpee}
20  SYS50000,I                          {initialize}
30  OPEN 8,8,8,"TESTLEXICON"
40  SYS50000,L :CLOSE8                  {load lexicon}
50  PRINT CHR$(147)                     {clear screen}
60  SYS50000,F                          {get utterance}
70  PRINT "COMMAND ";
80  IF CN=0 THEN PRINT "NONE" :GOTO 60   {unknown word}
90  ON CN GOTO 110,120,130,140,150
110 PRINT"#1"; :GOTO 200                 {command #1}
120 PRINT"#2"; :GOTO 200                 {command #2}
130 PRINT"#3"; :GOTO 200                 {command #3}
140 PRINT"#4"; :GOTO 200                 {command #4}
150 PRINT"#5"; :GOTO 200                 {command #5}
200 PRINT "HEARD" :GOTO 60
```

A more complex example is the Word Mix puzzle program on the VCM-64 master disk. This program is fully commented and may be listed for examination.

Lexicon Data

The lexicon can be examined to find the word label and command number present at each location. These data may be read by using the following BASIC statement:

```
POKE(53000),WL :SYS50000,R
```

The data for the command at word location (WL) will have its word label (LB$) and command number (CN) transferred to memory locations 53000-53018. These data may then be accessed the same as the recognition results above.

Disk Error Processing

All accesses to the disk to save or load files can result in errors. Usually, the disk drive LED indicator will remain flashing after the disk access if an error occurs. However, the type of error is not known, unless the following BASIC statements are used to print the error, if any, to the screen:

```
OPEN 15,8,15
INPUT#15,A$,B$,C$,D$
IF VAL(A$)>19 THEN PRINT B$ :CLOSE 15 : STOP
CLOSE 15
```

This routine should normally be done after every BASIC statement that causes a load or save to the disk.

Lexicon Filenames

The filename for a lexicon should be unique for each person and application. The filename can be the user's name or any other printable ASCII character string of up to 16 characters. Care should be taken not to use filenames already present on the VCM-64 master disk, as this may destroy one of the files used by the demonstration programs.

Advanced Programming

The advanced programmer may wish to examine the raw data from the VCM-64 and design their own recognition or data display software. This may be done by setting up the [illegible] program and VCM-64 as normal. Then when a recognition request is made by the BASIC statement:

```
SYS50000,F
```

the data for the received utterances will still be in the data buffers. These buffers are located in memory as follows:

```
X Data:    49152-49279   ($C000-$C07F)
Y Data:    49280-49407   ($C080-$C0FF)
```

The X Data will be a number between 0 and 127 with the first received data at location 49152 ($C000). The Y Data will be a number between 0 and 63 with the first received data at location 49280 ($C080). The Y Data is actually the lower 6 bits of the data byte, so the following BASIC statement should be used:

```
Y=PEEK(49280+M)AND 63
```

The value of M is the data point to be viewed (0 thru 127). Also, the bit-6 of the Y Data byte is a loudness flag that can be found by the following BASIC statement:

```
L=PEEK(49280+M)AND 64
```

This flag will be set if the received sound is louder than a specific level.

APPENDIX

MAKING BACKUP PROGRAMS

Good programming practice dictates that you always make backups of your diskettes. We encourage you to do the same (but only for your own personal use). Remember, backups are for your benefit. Unauthorized sale or distribution is unethical and violates federal copyright and patent laws and is subject to prosecution. Contact ENG Manufacturing, Inc. for license requirements.

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